IRAJ JAVANDEL
Earth Sciences Division
Department of Hydrogeology
E.0. Lawrence Berkeley National Laboratory

EDUCATION

Ph.D., 1968 (Civil Engineering), University of California, Berkeley
Major Field: Hydrogeology
Minor Fields: Mathematics and Hydraulics.

M.Sc., 1965 (Geological Engineering), University of California, Berkeley.

B.Sc., 1961 (Mining Engineering), University of Tehran, Tehran.

CURRENT POSITION

1989-present Senior Scientist, Earth Sciences Division,
Lawrence Berkeley National Laboratory (LBNL), University Of California.

1992-present Program Manager, Environmental Restoration Program, LBNL.

PROFESSIONAL EXPERIENCE

Co-Group Leader (1989-1993), Reservoir Engineering and Hydrogeology Group, Earth Sciences Division (ESD), LBNL.

Staff Scientist III and Principal Investigator (1980-1989), ESD, LBNL.

Technical Unit Manager (1989-1994), Environmental Restoration Program, LBNL.

Visiting Associate Professor and Associate Research Engineer (1973-1974) and (1978-1979), University of California, Berkeley.

Chairman, Dept. of Civil Engineering (1969-1973), Pahlavi University, Shiraz.

Associate Professor (1970-1980), Pahlavi University, Shiraz.

Assistant Professor (1969-1970), Pahlavi University, Shiraz.

Assistant Research Engineer (1968-1969), University of California, Berkeley.

Member of Editorial Board of Groundwater Journal (Jan. 1992-Dec. 1994).

RESEARCH EXPERIENCE

- Aquifer restoration
- Heat transfer aspects of nuclear waste isolation in crystalline rocks.
- Investigation of water resources of Livermore Valley, California.
- Study of hydrologic issues in site characterization for nuclear waste isolation in salt domes.
- *In situ* determination of properties and parameters controlling vertical groundwater movement in geological materials.
- Chemical transport in groundwater.
- Deep well injection.
- Study of key issues in aquifer restoration and contaminant cleanup.
- Contaminant transport in fractured porous rocks.
- Multiphase transport of petroleum hydrocarbons in subsurface environment.
- Capture-zone type curves for aquifer cleanup.
- Hydrologic detection of abandoned wells.
- Development of hydrologic techniques for detection and characterization of leaky faults and other potentially conductive structural features.
- Density driven flow of gas in the unsaturated zone due to the evaporation of volatile organic compounds.
- Dissolution and transport of nonaqueous phase liquids in groundwater.
- Soil vapor extraction.
- Thermally-enhanced vapor extraction

TEACHING EXPERIENCE

Taught Fluid mechanics, Introduction to fluid flow in rocks, Fluid flow in porous media (both analytical and numerical) in the Department of Civil Engineering at the University of California, Berkeley.

Taught short courses on Groundwater Modeling Methodology and Application for the EPA and other regulatory staff in Atlanta, Chicago, Dallas, New York, San Francisco and for the Arizona Department of Water Resources in Phoenix.

Taught Groundwater, Open Channel Hydraulics, Geological Engineering, Water Supply Engineering, Hydrology and Advanced Groundwater, (1969-1978), at Pahlavi University, Shiraz.

PUBLICATIONS

Books/ Book chapter

1. **Javandel, I**, Methods of Evaluating Vertical Ground Water Movement, National Water Well Association, 124 pp., 1985.

2. **Javandel, I.,** C. Doughty, and C.F. Tsang, Groundwater Transport: Handbook of Mathematical Models, American Geophysical. Union, Water Resources Monograph, 10, 228 pp., 1984, Fifth Printing 1995.

3. Witherspoon. P. A., **I. Javandel,** S.P. Neuman, and R.A. Freeze, Interpretation of Aquifer Gas Storage Conditions from Water Pumping Tests, American Gas Association Monograph, New York, 273 pp., June 1967.

4. **Javandel, I**, Pump and Treat, in Soil and Groundwater Contamination: Nonaqueous Phase Liquids, American Geophysical Union, Water Resources Monograph 17, Wash. DC, 2005.

5. **Javandel, I.** Occurrence of NAPLs in Clay or Rock Facture, in Soil and Groundwater Contamination: Nonaqueous Phase Liquids, American Geophysical Union, Water Resources Monograph 17, Wash. DC, 2005.

Refereed Journal Articles

1. Freeze, R. A., and **I. Javandel**, An interview with Paul Witherspoon, distinguished hydrogeologist from the USA, Hydrogeology Journal, Vol. 16, No. 5, pp. 811-815, 2008.

2. Seol, Y. and **I. Javandel**, Citric Acid- Modified Fenton's Reaction for the Oxidation of Chlorinated Ethylenes in Soil Solution Systems, *Chemosphere Journal,* Vol. 72, No. 4, pp. 537-542, 2008.

3. Shan, C., and **I. Javandel**, A Multilayered Box Model for Calculating Preliminary Remediation Goals in Soil Screening, *Risk Analysis Journal,* Vol. 25, No. 2, pp. 339-349, 2005.

4. Zhou, Q., J. T. Birkholzer, **I. Javandel,** and P. Jordan, Modeling Three-Dimensional Groundwater Flow and Advective Contaminant Transport at a Heterogeneous Mountainous Site in Support of Remediation, *Vadose Zone Journal*, Vol. 3, pp. 884-900, Aug. 2004.

5. Shan, C., **I. Javandel**, and P.A. Witherspoon, Characterization of Leaky Faults: Study of Air Flow in Faulted Vadoze Zone, Water Resources Research, Vol. 35, No. 7, pp. 2007-2013, 1999.

6. Shan, C., and **I. Javandel**, Analytical Solutions for Solute Transport in a Vertical Aquifer Section, *Journal of Contaminant Hydrology,* Vol. 27, No. 1-2, pp. 63-82, 1997.

7. Holman, H., and **I. Javandel,** Evaluation of Transient Dissolution of Slightly Water-Soluble Compounds from a Light Nonaqueous Phase Liquid Pool, *Water Resources Research, Vol.,* 32, No. 4, pp. 915-923, 1996.

8. Shan C., **I. Javandel**, and P.A Witherspoon, Characterization of Leaky Faults: Study of Water Flow in Aquifer-Fault-Aquifer system, *Water Resources Research, Vol.* 3 1, No. 12, pp. 2897-2904,1995.

9. Faybishenko, B., **I. Javandel,** and P.A Witherspoon, Hydrodynamics of the Capture Zone of a Partially Penetrating Well in a Confined Aquifer, *Water Resources Research,* Vol. 3 1, No. 2, pp. 859-866, 1995.

10. Shan, C., R. W. Falta, and **I. Javandel**, Analytical Solutions for Steady State Gas Flow to a Soil Vapor Extraction Well, *Water Resources Research,* Vol. 28, No. 4, pp. 1105-1120, 1992.

11. Falta, R. W., K. Pruess, **I. Javandel,** and P.A. Witherspoon, Numerical Modeling of Steam Injection for the Removal of Nonaqueous Phase Liquids From the Subsurface, 1. Numerical Formulation, *Water Resources Research, Vol.* 28, No. 2, pp. 433-449, 1992.

12. Falta, R. W., K. Pruess, **I. Javandel,** and P.A Witherspoon, Numerical Modeling of Steam Injection for the Removal of Nonaqueous Phase Liquids from the Subsurface, 2. Code Validation and Application, *Water Resources Research, Vol.* 28, No. 2, pp. 451-655, 1992.

13. Falta, R. W., **I. Javandel**, K. Pruess, and P.A Witherspoon, Density Driven Flow of Gas in the Unsaturated Zone Due to the Evaporation of Volatile Organic Compounds, *Water Resources Research, Vol.* 25, No. 10, pp. 2159-2169, 1989.

14. **Javandel, I.,** C. F. Tsang, P.A. Witherspoon, and D. Morganwalp, Hydrologic Detection of Abandoned Wells Near Proposed Injection Wells for Hazardous Waste Disposal, *Water Resources Research, Vol.* 24, No. 2, pp. 261-270, 1988.

15. **Javandel, I.,** and C.F. Tsang, Capture-Zone Curves: A Tool for Aquifer Cleanup, *Journal of Ground Water, Vol.* 24, No. 5, pp. 616-625, 1986.

16. **Javandel, I.,** and P.A Witherspoon, Analytical Solution of a Partially Penetrating Well in a Two-Layer Aquifer, *Water Resources Research, Vol.* 19, No. 2, pp. 567-578, 1983.

17. **Javandel, I.,** and P.A Witherspoon, A Semianalytical Solution for Partial Penetration in Two-Layer Aquifers, *Water Resources Research,* Vol. 16, No. 6, pp. 1099-1106, 1980.

18. **Javandel, I.,** and N. Zaghi, Analysis of Flow to an Extended Fully Penetrating Well, *Water Resources Research, Vol.* 11, No. 1, pp. 159-164, 1975.

19. **Javandel, I.,** and P.A Witherspoon, A Method of Analyzing Transient Fluid Flow in Multi-layered Aquifers, *Water Resources Research,* Vol. 5, No. 4, pp. 856-869, 1969.

20. **Javandel, I.,** and P.A Witherspoon, Application de la method des Elements Finis aux. Ecoulments Transitories en Milieu Poreau, *Revue de L'Institute Francais du Petrole, Vol.* 23, No. 12, pp. 1509-1529, 1968.

21. **Javandel, I.,** and P.A Witherspoon, Application of the Finite Element Method to Transient Flow in Porous Media, *Society of Petroleum Engineers Journal, Vol.* 8, No. 3, pp. 241-242, 1968.

22. **Javandel, I.,** and P.A. Witherspoon, Use of Thermal Model to Investigate the Theory of Transient Flow to a Partially Penetrating Well, *Water Resources Research, Vol. 3, No. 2, pp. 591-597,1967.*

23. Goodman, R.E., D.G. Moye, A. Van Schalkwyk, and **I. Javandel,** Groundwater Inflow During Tunnel Driving, *Engineering Geology (AEG),* pp. 39-56, January *1965.*

Other Publications

1. Diamond, D., D. Baskin, D. Brown, L. Lund, J. Najita and **I. Javandel**, Analysis of Background Distributions of Metals in Soil at Lawrence Berkeley National Laboratory, LBNL-1782E, April 2009.

2. Zhou, Q., T. Birkholzer, **I. Javandel** and P. D. Jordan, Simulation of Groundwater Flow at the LBNL Site Using TOUGH2, Proceedings, TOUGH Symposium 2003, Lawrence Berkeley National Laboratory, Berkeley, California.

3. **Javandel, I.,** A Review of Contaminant Migration in Karst/Fractured Rocks, Proceedings of Second International Symposium on Karst Water Resources, pp. 273-291, 1998.

4. Shan, C., H.Y. Holman, and **I. Javandel,** A Pitfall and its Solution in Monitoring and Cleanup Groundwater Contamination by Petroleum Products, Abstract, AGU Fall Meeting, 1997.

5. **Javandel, I.,** Nonattainment Policy: A Viable Approach for Groundwater Remediation, Proceedings of *American Chemical Society,* Emerging Technologies in Hazardous Waste Management VII, pp. 1004-1006, held in Atlanta, Sept. 17-20, 1995.

6. Lee, K. H., C. Shan and **I. Javandel**, Electrical Resistivity for Detecting Subsurface Non-Aqueous Phase Liquids: A Progress Report, Lawrence Berkeley Laboratory Report, LBL-37339, June 1995.

7. Wang. J., N Cook, H. Wollenberg, C. Carnahan, **I. Javandel,** and C. F. Tsang, Geohydrologic Data and Models of Rainier Mesa and their Implications to Yucca Mountain, Lawrence Berkeley Laboratory Report, LBL-33627, Jan. 1993.

8. **Javandel, I.,** and C. Shan, Hydrologic Characterization of Faults and Other Potentially Conductive Features in Unsaturated Zone, Proceedings of the High Level Radioactive Waste Management Conference, Las Vegas, pp. 1185-1191, 1990.

9. **Javandel, I.,** On the Field Determination of Effective Porosity, invited paper, in The Proceedings of New Field Techniques Conference, National Water Well Association, pp. 155-172, 1989.

10. **Javandel, I.,** and C.F. Tsang, Aquifer Restoration: Issues, Methodologies and Cost Effectiveness, Lawrence Berkeley National Laboratory Report, 253 pp., 1988.

11. **Javandel, I.,** R. Falta, and H. Holman, Hydrocarbon Contaminants in Sallow Soil Systems, in The Proceedings of Second Berkeley Symposium on Topics in Petroleum Engineering, Lawrence Berkeley National Laboratory, LBNL-24337, Berkeley, CA, 82 pp., 1988.

12. **Javandel, I.,** and P.A. Witherspoon, Deep Well Disposal, in The Proceedings of Second Berkeley Symposium on Topics in Petroleum Engineering, Lawrence Berkeley National Laboratory, LBNL-24337, Berkeley, CA, 82 pp., 1988.

13. Holman, H., and **I. Javandel,** Dissolution and Transport of Slightly Water-Soluble Gasoline Components in Groundwater, Presented at the Fall Meeting of American Geophysical Union, Abstract in EOS Vol. 68, No. 44, pp. 1284, 1987.

14. Falta, R., and **I. Javandel,** A Numerical Method for Multiphase Multicomponent Contaminant Transport in Groundwater, Presented at the Fall Meeting of American Geophysical Union, Abstract in EOS Vol. 68, No. 44, pp. 1284,1987.

15. **Javandel, I.,** and C. F. Tsang, Contaminant Migration in Fractured Porous Rocks, Phase 1: Preliminary Studies of Hydrologic Aspects, Lawrence Berkeley National Laboratory, Berkeley, CA, 106 pp., 1986.

16. **Javandel, I.,** Application of Capture-Zone Type Curves for Aquifer Cleanup, in Groundwater Hydrology, Contamination, and Remediation, pp.249-280, edited by R. M. Khanbilvardi and J. Fillos, Scientific Publications Co., Washington D. C., 1986.

17. **Javandel, I.,** C.F. Tsang, and P.A. Witherspoon, Hydrologic Detection of Abandoned Wells, Lawrence Berkeley National Laboratory, LBNL-21888, 78 pp., 1986.

18. **Javandel, I.,** Analytic and Semianalytic Methods for Predicting the Extent of Contamination in Groundwater and Aquifer Restoration, in The Proceeding of Groundwater Technology: Pollution and Transport, edited by R. M. Khanbilvardi and J. Fillos, The City College of the City University of New York, pp. 109-151, 1985.

19. **Javandel, I.,** C.F. Tsang, and Y.Y. Haimes, Practical Guide to Aquifer Restoration: Issues, Methodologies and Cost Effectiveness Lawrence Berkeley National Laboratory, LBNL-20504, 317 pp., 1985.

20. **Javandel, I.,** Techniques for Measuring the Vertical Hydraulic Conductivity of Flood Basalts at the Basalt Waste Isolation Project Site. Lawrence Berkeley National Laboratory, LBNL-16578, 66 pp., June 1983.

21. **Javandel, I.,** Field Determination of the Hydrologic Properties and Parameters that Control the Vertical Component of Groundwater Movement, Lawrence Berkeley National Laboratory, LBNL-15050,116 pp., March 1983.

22. Tsang, C. F., D.C. Mangold, C. Doughty, and **I. Javandel,** A Study of Contaminant Plume Control in Fractured-Porous Media in Proceedings of the Third National Symposium on Aquifer Restoration and Ground-Water Monitoring, edited by D. M. Nielsen, National Water Well Association, pp. 446-452, 1983.

23. **Javandel, I.,** and P.A Witherspoon, Pressure Transient Testing with a Partially Penetrating Well in a Two-Layer Reservoir, presented at the 57th Annual Conference of the Society of Petroleum Engineers of AIME, September 1982.

24. **Javandel, I.,** Analytical Solutions in Subsurface Fluid Flow, in Recent Trends in Hydrogeology, edited by T N. Narasimhan, of *Geological Society America,* special paper 189, pp. 223-235, 1982.

25. **Javandel, I.,** and P.A Witherspoon, Thermal Analysis of the Stripa Heater Test Data From the Full Scale Drift, Lawrence Berkeley National Laboratory, LBNL-13217, 124 pp., August 1981.

26. Chan, T., P.A Witherspoon, and **I. Javandel**, Heat Transfer in Underground Heating Experiments in Granite, Stripa, Sweden, in Heat Transfer in Nuclear Waste Disposal, American Society of Mechanical Engineers, TD, Vol. 11, pp. 1-8, 1980.

27. **Javandel, I.,** Application of Numerical Inversion of Laplace Transformation for Solving Groundwater Problems, invited paper Proceedings of International Seminar on Regional Groundwater Hydrology and Modeling, pp. 373-401, 1976.

28. Witherspoon, P.A., **I. Javandel**, and S. P. Neuman, Use of the Finite Element Method in Solving Transient Flow Problems in Aquifer Systems, in The Use of Analog and Digital Computers in Hydrology, Publication No. 81, International Association of Scientific Hydrology, 1968.

29. **Javandel, I.,** Analysis of Transient Fluid Flow in Multi-Layered Systems, Ph.D. Thesis, University of California, Berkeley, 1968.

30. **Javandel, I.,** Verification of Analytical Solution for Partial Penetration Wells by Mathematical and Heat Transfer Models, M.S. Thesis, University of California, Berkeley, *1965.*

AWARDS AND HONORS

Outstanding Performance Award for outstanding achievement in support of the mission and goals of the Lawrence Berkeley National Laboratory, from LBNL Director and EH&S Director, February 2003.

Outstanding Performance Award for outstanding achievement in support of the mission and goals of the Lawrence Berkeley National Laboratory, from LBNL Director, ESD Director, and EH&S Director, November 2000.

Outstanding Performance Award from LBNL Director and ESD Director, September 1993.

Jane Lewis Fellowship, University of California at Berkeley, two years, 1964-1966.

Four-years scholarship for graduate studies in the United States of America.

PROFESSIONAL AFFILIATIONS

Member of the American Geophysical Union.

Member of the Association of Ground Water Scientists and Engineers.